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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 09/824,936 | 04/03/2001 | Jacques Schmitt | H37-091 DIV | 9938 |

21706 7590 01/11/2007

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| EXAMINER | |
|---|---|
| CROWELL, ANNA M | |
| **ART UNIT** | **PAPER NUMBER** |
| 1763 | |

| SHORTENED STATUTORY PERIOD OF RESPONSE | MAIL DATE | DELIVERY MODE |
|---|---|---|
| 2 MONTHS | 01/11/2007 | PAPER |

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5

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**BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

Application Number: 09/824,936
Filing Date: April 03, 2001
Appellant(s): SCHMITT, JACQUES

MAILED

JAN 11 2007

GROUP 1700

Chih-Sheng Lin
For Appellant

**EXAMINER'S ANSWER**

This is in response to the appeal brief filed November 13, 2006 appealing from the Office action mailed May 11, 2006.

**(1) Real Party in Interest**

A statement identifying by name the real party in interest is contained in the brief.

**(2) Related Appeals and Interferences**

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

**(3) Status of Claims**

The statement of the status of claims contained in the brief is substantially correct. Claims 1-4 and 6-12 are pending in the application. Claims 2 and 9-12 are withdrawn from consideration. Claims 1, 3, 4, and 6-8 are finally rejected.

**(4) Status of Amendments After Final**

No amendment after final has been filed.

**(5) Summary of Claimed Subject Matter**

The summary of claimed subject matter contained in the brief is correct. The present invention is directed to a capacitively coupled RF plasma reactor.

The apparatus includes a reactor, two electrically conductive electrodes spaced parallel from each other, a gas providing means for providing a reactive gas, a radio-frequency generator connected to at least one electrode and having frequencies greater than 13.56 MHz, a means for evacuating a reactive gas from the chamber, at least one substrate with a largest dimension of at least 0.7 m, and at least one dielectric "corrective" layer having at least one non-planar external surface and having capacitance per unit surface values which is not uniform along at least one direction of a surface . The dielectric "corrective" layer compensates for process non uniformity that occurs in a plasma reactor.

**(6) Grounds of Rejection to be Reviewed on Appeal**

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct. The issues are if:

1. Claims 1, 3, 4, and 6-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hanada (Japanese Patent Publication 08-186094) in view of Shang et al. (U.S. 6,177,023) and Collins et al. (U.S. 5,210,466).

2. Claims 1, 3, 4, and 6-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hanada (Japanese Patent Publication 08-186094) in view of Shang et al. (U.S. 6,177,023) and Sato et al. (6,199,505).

**(7) Claims Appendix**

The copy of the appealed claims contained in the Appendix to the brief is correct.

**(8) Evidence Relied Upon**

| | | |
|---|---|---|
| 08-186094 | Hanada (Japan) | 07-1996 |
| 6,177,023 | Shang et al. | 01-2001 |
| 5,210,466 | Collins et al. | 05-1993 |
| 6,199,505 | Sato et al. | 03-2001 |

**(9) Grounds of Rejection**

The following ground(s) of rejection are applicable to the appealed claims:

**Claims 1, 3, 4, and 6-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hanada (Japanese Patent Publication 08-186094) in view of Shang et al. (U.S. 6,177,023) and Collins et al. (U.S. 5,210,466).**

Referring to Drawings 1 and 2 and the abstract, Hanada discloses a capacitively coupled radio frequency plasma reactor 19 comprising: at least two electrically conductive electrodes 12 and 21 spaced from each other, each electrode having an external surface, an internal process space 11 enclosed between the electrodes, a gas providing means 16 for providing the internal process space with a reactive gas, at least one radio frequency generator 29 connected to at least one of the electrodes, at a connection location, for generating a plasma discharge in the process space, a means 26 to evacuate the reactive gas from the reactor, at least one substrate 1 defining one limit of the internal process space, to be exposed to the processing action of the plasma discharge, the at least one substrate extends along a general surface and is arranged between the electrodes, at least one dielectric layer 21a has at least one non planar-shaped external surface (Fig. 2 and abstract) extending outside the internal process space, the dielectric layer being a

capacitor that is electrically in series with the substrate and the plasma, and the dielectric layer having a capacitance per unit surface values which are not uniform along at least one direction of the general surface, for generating a given distribution profile, especially for compensating a process non uniformity in the reactor.

Hanada fails to teach a radio frequency generator for frequencies greater than 13.56 MHz and at least one substrate with a largest dimension of at least 0.7m.

Referring to column 4, lines 26-47, Collins et al. discloses a capacitively coupled radio frequency plasma reactor using a radio frequency generator which applies frequencies greater than 13.56 MHz (50-800 MHz) since higher frequencies provide commercially viable processing rates and substantial reduction in sheath voltages. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention for the radio frequency generator of Hanada to apply frequencies greater than 13.56 MHz as taught by Collins et al. since higher frequencies provide commercially viable processing rates and substantial reduction in sheath voltages.

Referring to column 5, lines 58-63, Shang et al. teaches a plasma reactor for processing a substrate for flat panel displays with a largest dimension up to 1m. It is well known in the art to scale up or down an apparatus to accommodate the desired substrate size. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to provide the apparatus of Hanada with a substrate having a largest dimension up to 1m in order to process substrates for flat panel displays and furthermore since it is well known in the art to scale up or down an apparatus to accommodate the desired substrate size and. Additionally, where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform

differently than the prior art device, the claimed device was not patentably distinct from the prior art device (In Gardner v. TEC Systems, Inc., 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984)).

With respect to the "internal process space having a size to normally form a standing wave spacial oscillation therein", it should be noted that the combination of Hanada, Shang, and Collins teaches a structure of a large-sized reactor operating at above 13.56 MHz and processing a large substrate with a dimension larger than 0.7 m. In addition, while features of an apparatus may be recited either structurally or functionally, claims directed to an apparatus must be distinguished from the prior art in terms of structure rather than function (In re Schreiber, 128 F.3d 1473, 1477-78, 44 USPQ2d 1429,1431-32 (Fed. Cir. 1997)). In the instant case and stated above, the apparatus of Hanada, Shang, Sato, and Collins teaches the structural limitations, thus it is inherent that at high frequencies above 13.56 MHz and a large reactor sized to accommodate a 1 m substrate, standing wave oscillations will occur between the chamber walls.

With respect to claim 3, the dielectric layer 21a has a thickness "a" along a direction perpendicular to the general surface of the substrate 1, the thickness being non uniform along the dielectric layer, so that the reactor has a location-dependent capacitance per unit surface values along the general surface (Fig. 2 and abstract).

With respect to claim 4, the dielectric layer 21a is the thickest in front of the location in the process space 11 which is the furthest away from the connection location where the radio frequency generator 29 is connected to the at least one electrode and the thickness decreases from the process space location as the distance between the process space location and the connection location on the corresponding electrode decreases (Fig. 1 and abstract).

With respect to claim 6, at least one of the electrodes 21 has a non planar-shaped surface facing the substrate 1 (Figs. 1 and 2).

With respect to claim 7, the dielectric layer 21a is locally delimited by a surface of one of the electrodes 21, and the delimitation surface of the one electrode is curved (Fig. 1 and 2).

With respect to claim 8, the dielectric layer comprises a solid dielectric layer (Figs. 1, 2 and abstract).

**Claims 1, 3, 4, and 6-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hanada (Japanese Patent Publication 08-186094) in view of Shang et al. (U.S. 6,177,023) and Sato et al. (6,199,505).**

Referring to Drawings 1 and 2 and the abstract, Hanada discloses a capacitively coupled radio frequency plasma reactor 19 comprising: at least two electrically conductive electrodes 12 and 21 spaced from each other, each electrode having an external surface, an internal process space 11 enclosed between the electrodes, a gas providing means 16 for providing the internal process space with a reactive gas, at least one radio frequency generator 29 connected to at least one of the electrodes, at a connection location, for generating a plasma discharge in the process space, a means 26 to evacuate the reactive gas from the reactor, at least one substrate 1 defining one limit of the internal process space, to be exposed to the processing action of the plasma discharge, the at least one substrate extends along a general surface and is arranged between the electrodes, at least one dielectric layer 21a has at least one non planar-shaped external surface (Fig. 2 and abstract) extending outside the internal process space, the dielectric layer being a capacitor that is electrically in series with the substrate and the plasma, and the dielectric layer having a capacitance per unit surface values which are not uniform along at least one direction of

the general surface, for generating a given distribution profile, especially for compensating a process non uniformity in the reactor.

Hanada fails to teach a radio frequency generator for frequencies greater than 13.56 MHz and at least one substrate with a largest dimension of at least 0.7m.

Referring to column 2, lines 37-65, column 4, line 40-column 5, line 40, Sato et al. discloses a capacitively coupled radio frequency plasma reactor designed to use a radio frequency generator which applies frequencies greater than 13.56 MHz (30-300 MHz) (col. 2, lines 53-56) and that processes a substrate with a largest dimension of at least 0.7m (1 m) (col. 2, lines 37-44) since it is important to uniformly process large substrates at high frequencies with a reduced weight, dimension, and cost to the overall apparatus. Additionally, higher frequencies provide commercially viable processing rates and substantial reduction in sheath voltages and larger substrates yield increased product throughput. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to design the reactor of Hanada to apply frequencies greater than 13.56 MHz and accommodate at least one substrate with a largest dimension of at least 0.7m. as taught by Sato et al. since there is a growing demand in industry to uniformly process large substrates at high frequencies with a reduced weight, dimension, and cost to the overall apparatus. Additionally, higher frequencies provide commercially viable processing rates and substantial reduction in sheath voltages and larger substrates yield increased product throughput.

Moreover, referring to column 5, lines 58-63, Shang et al. teaches a plasma reactor for processing a substrate for flat panel displays with a largest dimension up to 1m. It is well known in the art to scale up or down an apparatus to accommodate the desired substrate size.

Additionally, it is well known in the art to scale up/down the power in order to accommodate the desired substrate size (col. 6, lines 58-60). Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to provide the apparatus of Hanada with a substrate having a largest dimension up to 1m with appropriate power level in order to process substrates for flat panel displays and furthermore since it is well known in the art to scale up or down an apparatus to accommodate the desired substrate size. Additionally, where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device (In Gardner v. TEC Systems, Inc., 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984)).

With respect to the "internal process space having a size to normally form a standing wave spacial oscillation therein", it should be noted that the combination of Hanada, Shang, and Sato teaches a structure of a large-sized reactor operating at above 13.56 MHz and processing a large substrate with a dimension larger than 0.7 m. In addition, while features of an apparatus may be recited either structurally or functionally, claims directed to an apparatus must be distinguished from the prior art in terms of structure rather than function (In re Schreiber, 128 F.3d 1473, 1477-78, 44 USPQ2d 1429,1431-32 (Fed. Cir. 1997)). In the instant case and stated above, the apparatus of Hanada, Shang, Sato, and Collins teaches the structural limitations, thus it is inherent that at high frequencies above 13.56 MHz and a large reactor sized to accommodate a 1 m substrate, standing wave oscillations will occur between the chamber walls.

With respect to claim 3, the dielectric layer 21a has a thickness "a" along a direction perpendicular to the general surface of the substrate 1, the thickness being non uniform along the dielectric layer, so that the reactor has a location-dependent capacitance per unit surface values along the general surface (Fig. 2 and abstract).

With respect to claim 4, the dielectric layer 21a is the thickest in front of the location in the process space 11 which is the furthest away from the connection location where the radio frequency generator 29 is connected to the at least one electrode and the thickness decreases from the process space location as the distance between the process space location and the connection location on the corresponding electrode decreases (Fig. 1 and abstract).

With respect to claim 6, at least one of the electrodes 21 has a non planar-shaped surface facing the substrate 1 (Figs. 1 and 2).

With respect to claim 7, the dielectric layer 21a is locally delimited by a surface of one of the electrodes 21, and the delimitation surface of the one electrode is curved (Fig. 1 and 2).

With respect to claim 8, the dielectric layer comprises a solid dielectric layer (Figs. 1, 2 and abstract).

**(10) Response to Argument**

A. Appellant has argued that Collins does not disclose a capacitively coupled RF plasma reactor. First of all, a capacitively coupled RF plasma reactor is simply an apparatus wherein plasma is generated between electrodes (an anode and a cathode). The anode can be a chamber wall or an electrode isolated from the chamber wall. It should be noted that Collins et al. is a

capacitively coupled RF plasma reactor since the plasma is generated between the cathode 32C and the anode 12, 13, 27. Additionally, two electrodes (anode and cathode, i.e. parallel plate electrodes) that are isolated from the wall could be used instead of using the chamber as the anode (Collins et al.-col. 5, lines 1-18). Moreover, Sato et al.'505 clearly states that apparatus of Collins et al.'466 is a capacitively coupled RF plasma reactor (Sato et al.-col. 1, lines 33-36). Thus, the teachings of Hanada'094 in view of Collins et al.'466 and Shang et al.'023 satisfy the claimed requirements.

B. Appellant has argued that those of ordinary skill in the art would not be motivated to use a high frequency generator of Collins et al. that applies frequencies greater than 13.56 MHz in Hanada. The Examiner recognizes that obviousness can only be established by combining or modifying the teaching, suggestion, or motivation to dos so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the motivation to modify the high frequency generator of Hanada with a high frequency generator that applies frequencies greater than 13.56 MHz of Collins et al. is to enhance commercially viable processing rates. Thus, the teachings of Hanada'094 in view of Collins et al.'466 and Shang et al.'023 satisfy the claimed requirements.

C. Appellant has argued that there is no motivation to scale up the plasma chamber of Hanada to process a substrate with a largest dimension of at least 0.7 m as taught by Shang since Shang utilizes a plate-charge inducing plasma to create electrostatic attraction between the

substrate and support layer and thus plasma density uniformity is not necessary. Shang et al. was applied to teach that it is conventionally known in the art to plasma process substrates with a dimension greater than 0.7 m (i.e. 1.0 m). The invention of Shang et al. discloses the use of plate-charge inducing plasma in order to create charges on the surfaces of the substrates and the support layer; however, also Shang et al. discusses generating plasma for the purpose of plasma deposition (Shang et al.-col. 5, lines 8-19). Furthermore, the only difference between plate-charge inducing plasma and plasma for deposition is the type of gases used in the chamber (Shang et al.-col. 8, lines 4-15). Thus, the concept of scaling up the power to process a larger substrate (i.e. > 0.7 m) would apply to plasma deposition. Therefore, the teachings of Hanada'094 in view of Collins et al.'466 and Shang et al.'023 satisfy the claimed requirements.

D. Appellant has argued that Sato fails to offer any suggestions for compensating for the non-uniformities in the plasma density when utilizing RF frequencies higher than 13.56 MHz to process large size substrates (>=0.7m). The present rejection is applied to apparatus claims. The requirement of apparatus claims simply means that the prior art must teach the claimed structure and does not necessarily address the problem (standing wave effect) and solution presented in the current invention. In the instant case, the shape of the dielectric layer 21a (structure) and lower electrode 21b (structure) of Hanada promotes plasma uniformity and thus would compensate for non-uniformity due to the standing wave effect that will occur when operating at higher frequencies or processing larger substrates. Sato et al. was simply applied for the teaching of applying frequencies greater than 13.56 MHz with a substrate having a largest dimension of at least 0.7m in order to enhance processing rates. Furthermore, it should be noted that one cannot

show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Thus, the combination of Hanada'094 in view of Shang et al.'023 and Sato et al. '505 satisfy the claimed requirements.

In summary, each of the rejected claims is obvious for the reasons argued at length above. It is respectfully stressed that Hanada was applied to show the structure of a parallel plate plasma reactor including a dielectric layer having at least one non-planar external surface and having a capacitance per unit surface values which are not uniform along at least one direction of the general surface. Collins et al., Shang et al. and Sato et al. were applied to teach having a radio frequency generator for frequencies greater than 13.56 MHz and at least one substrate with a largest dimension of at least 0.7 m. Thus, the combination of Hanada'094 in view of Collins et al.'466, Shang et al.'023 and Sato et al. '505 satisfy the claimed requirements

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Michelle Crowell — Assistant Examiner — A. Michelle Crowell

January 8, 2007

Parviz Hassanzadeh — Supervisory Examiner — P. Hassanzadeh

Gregory Mills — Appeal Conferee — jlm for Greg Mills

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